

One-carbon (bio?)geochemistry in subsurface waters of the serpentinizing Coast Range Ophiolite

Tori M. Hoehler, NASA Ames Research Center

Tom McCollom, LASP, University of Colorado, Boulder

Matt Schrenk, East Carolina University

Dawn Cardace, University of Rhode Island

Serpentinization – the aqueous alteration of ultramafic rocks – typically imparts a highly reducing and alkaline character to the reacting fluids. In turn, these can influence the speciation and potential for metabolism of one-carbon compounds in the system. We examined the aqueous geochemistry and assessed the biological potential of one-carbon compounds in the subsurface of the McLaughlin Natural Reserve (Coast Range Ophiolite, California, USA). Fluids from wells sunk at depths of 25-90 meters have pH values ranging from 9.7 to 11.5 and dissolved inorganic carbon (DIC concentrations) generally below 60 micromolar. Methane is present at concentrations up to 1.3 millimolar (approximately one-atmosphere saturation), and hydrogen concentrations are below 15 nanomolar, suggesting active consumption of H_2 and production of CH_4 . However, methane production from CO_2 is thermodynamically unfavorable under these conditions. Additionally, the speciation of DIC predominantly into carbonate at these high pH values creates a problem of carbon availability for any organisms that require CO_2 (or bicarbonate) for catabolism or anabolism. A potential alternative is carbon monoxide, which is present in these waters at concentrations 2000-fold higher than equilibrium with atmospheric CO . CO is utilized in a variety of metabolisms, including methanogenesis, and bioavailability is not adversely affected by pH-dependent speciation (as for DIC). Methanogenesis from CO under in situ conditions is thermodynamically favorable and would satisfy biological energy requirements with respect to both Gibbs Energy yield and power.